

TOUCH-SENSITIVE SHEET MEMBER, INPUT DEVICE AND ELECTRONIC APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Japanese Patent Application JP 2007-330715 filed in the Japanese Patent Office on Dec. 21, 2007, the entire contents of which is being incorporated herein by reference.

BACKGROUND

[0002] In recent years, a user (the operator) has often used a digital camera equipped with various kinds of operation modes to shoot a subject and has often taken various kinds of contents in a mobile phone or an information mobile terminal such as a Personal Digital Assistants (PDA) to utilize them. The digital camera, mobile terminal device and the like have their input devices. An input unit such as a key board and a JOG dial, a touch panel formed by combining a display unit, and the like has been often used for the input device. Further, an input device in which display contents are changed over when the user's finger slides on a display screen has developed.

[0003] Japanese Patent Application Publication No. H02-230310 has disclosed on page 2 and FIG. 1 thereof a menu selection device relating to a function of the above-mentioned input device. This menu selection device has an item selection means and an item input means. The item input means is provided on the item selection means, selection and input of the item are assigned to the same key, and an item display key and an item selection and input key are provided in parallel.

[0004] Japanese Patent Application Publication No. 2005-063227 has disclosed on page 8 and FIG. 15 thereof another input device. This input device has a window aperture that is provided at a predetermined position of a casing. The item selection is executed by sliding an operation button exposed from this window aperture. A predetermined region in a specified item selection screen is expanded and displayed by pressing the other operation knob.

[0005] Japanese Patent Application Publication No. 2004-070505 has disclosed on page 5 and FIG. 3 thereof an input device accompanied with vibration, which is mountable on an electronic apparatus such as an air-conditioner, an audio or the like. This input device is provided with an operation member that is used concurrently as functions of a rotary switch, a push switch and a slide switch. Selection of the operation item or the input determination operation is executed by rotating, sliding or pushing down the operation member and any vibration is accompanied at a time of the input determination operation.

[0006] An input device combined with an actuator has been also developed. The actuator is made by bonding piezoelectric devices having two layers or more which have different distortion amounts or by bonding a piezoelectric device and a non-piezoelectric device. When a vibration control voltage is applied to the bonded piezoelectric devices and the like, the actuator dynamically utilizes bending deformation of the bonded piezoelectric devices and the like, which occurs based on any difference in the distortion amounts between them (vibration body function thereof).

[0007] Japanese Patent Application Publication No. 2004-094389 has disclosed on page 9 and FIG. 4 thereof an input-

output device and an electronic apparatus, which are provided with such a piezoelectric actuator. This electronic apparatus is provided with an input-output device including a multi-layer piezoelectric actuator of bi-morph type and a touch panel, and this piezoelectric actuator feeds back different senses of touch corresponding to kinds of information through the touch panel to the user. The input-output device has a piezoelectric-member-supporting structure in which a piezoelectric actuator is mounted on the support frame through a support portion. The support portion is bonded on a center upper portion of the piezoelectric actuator and/or this support portion is attached to the touch panel. Supplying a vibration control voltage to the piezoelectric actuator allows a vibration to be transmitted to the touch panel.

[0008] The electronic apparatuses disclosed in Japanese Patent Application Publication No. H02-230310 mounts an input device with the touch input function in which the touch panel and the display unit are combined, but when an icon is selected on the display unit, the sense of touch synchronized with the selection thereof is not given to the operator.

[0009] Also, the input devices disclosed in Japanese Patent Application Publications Nos. 2005-063227 and 2004-070505 give a key operation feeling to an operator based on a sense of touch that a finger of the operator feels when a dome-shaped switch is pushed down. However, the sense of touch that the finger of the operator feels is given by only a uniform vibration or a force change mainly within a contact surface of the finger and an input surface.

[0010] The input device disclosed in Japanese Patent Application Publication No. 2004-094389 introduces a plurality of piezoelectric actuators with respect to improvement of input operability using the touch-sensitive device to reinforce the representation based on the sense of touch. However, an effective contact area of an operator's finger and an input surface for receiving vibration is small with respect to a size (outside one) of each of the piezoelectric actuators. It is difficult to represent a great variety of force changes in the input surface thereof.

[0011] It is desirable to provide a touch-sensitive sheet member, an input device and an electronic apparatus in which concave shapes or convex shapes for representing sense of touch are built at predetermined positions by devising a structure and a function of a touch sheet member and by which it is possible to improve operability in the touch sheet or compatibility in the nonskid sheet.

SUMMARY

[0012] The present application relates to a touch-sensitive sheet member and an input device using the same, which are applicable to an electronic apparatus such as a digital camera, a video camera, a mobile phone, a mobile terminal device, a desk-top type personal computer (hereinafter referred to as PC), a note type PC, and a braille block apparatus including a touch-sensitive input function for presenting a sense of touch when touching an icon screen with an operator's finger or the like.

[0013] According to an embodiment, there is provided a touch-sensitive sheet member including a body having predetermined hardness and a sheet shape and a sense-of-touch-representing unit that represents a sense of touch. The sense-of-touch-representing unit has a predetermined size and is arranged at positions of the body or at a predetermined position of the body. The touch-sensitive sheet member also